

# **Coho and Chinook Salmon Smolt Releases into Cook Inlet, Prince William Sound, and Resurrection Bay, Alaska, 2007**

by

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and

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February 2010

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mid eye to fork	MEF
gram	g	all commonly accepted		mid eye to tail fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.	<b>Mathematics, statistics</b>	
meter	m			<i>all standard mathematical</i>	
milliliter	mL	at	@	<i>signs, symbols and</i>	
millimeter	mm	compass directions:		<i>abbreviations</i>	
		east	E	alternate hypothesis	H <sub>A</sub>
<b>Weights and measures (English)</b>		north	N	base of natural logarithm	<i>e</i>
cubic feet per second	ft <sup>3</sup> /s	south	S	catch per unit effort	CPUE
foot	ft	west	W	coefficient of variation	CV
gallon	gal	copyright	©	common test statistics	(F, t, $\chi^2$ , etc.)
inch	in	corporate suffixes:		confidence interval	CI
mile	mi	Company	Co.	correlation coefficient	
nautical mile	nmi	Corporation	Corp.	(multiple)	R
ounce	oz	Incorporated	Inc.	correlation coefficient	
pound	lb	Limited	Ltd.	(simple)	r
quart	qt	District of Columbia	D.C.	covariance	cov
yard	yd	et alii (and others)	et al.	degree (angular )	°
		et cetera (and so forth)	etc.	degrees of freedom	df
<b>Time and temperature</b>		exempli gratia		expected value	<i>E</i>
day	d	(for example)	e.g.	greater than	>
degrees Celsius	°C	Federal Information		greater than or equal to	≥
degrees Fahrenheit	°F	Code	FIC	harvest per unit effort	HPUE
degrees kelvin	K	id est (that is)	i.e.	less than	<
hour	h	latitude or longitude	lat. or long.	less than or equal to	≤
minute	min	monetary symbols		logarithm (natural)	ln
second	s	(U.S.)	\$, ¢	logarithm (base 10)	log
		months (tables and		logarithm (specify base)	log <sub>2</sub> , etc.
<b>Physics and chemistry</b>		figures): first three		minute (angular)	'
all atomic symbols		letters	Jan.,...,Dec	not significant	NS
alternating current	AC	registered trademark	®	null hypothesis	H <sub>0</sub>
ampere	A	trademark	™	percent	%
calorie	cal	United States		probability	P
direct current	DC	(adjective)	U.S.	probability of a type I error	
hertz	Hz	United States of		(rejection of the null	
horsepower	hp	America (noun)	USA	hypothesis when true)	$\alpha$
hydrogen ion activity	pH	U.S.C.	United States	probability of a type II error	
(negative log of)			Code	(acceptance of the null	
parts per million	ppm	U.S. state	use two-letter	hypothesis when false)	$\beta$
parts per thousand	ppt, ‰		abbreviations	second (angular)	"
			(e.g., AK, WA)	standard deviation	SD
volts	V			standard error	SE
watts	W			variance	
				population	Var
				sample	var

***FISHERY DATA SERIES NO. 10-04***

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INLET, PRINCE WILLIAM SOUND, AND RESURRECTION BAY,  
ALASKA, 2007**

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## ABSTRACT

Approximately 951,964 coho salmon *Oncorhynchus kisutch* smolt and 1,297,550 Chinook salmon *O. tshawytscha* smolt were released in Cook Inlet, Prince William Sound, and Resurrection Bay in 2007. All 17 release groups were thermally marked to later identify the area of release for returning adult salmon. All 274,028 Chinook salmon from three release groups were also marked with an adipose finclip and a coded wire tag. Tag retention for individual release groups ranged from 99.7% to 100.0%. Acceptable adipose finclips ranged from 99.5% to 100%. Fish size distribution at time of release was estimated for the three release groups of Chinook salmon with coded wire tags and one release group of coho salmon without coded wire tags. All three coded wire tag Chinook salmon release groups achieved a Chinook salmon production goal of 80% of smolt within a 5.1-15.0 g target size range. The production goal for coho salmon is to have 80% of the smolt within a 15.1-25.0 g target size range. The percentage of coho salmon smolt within the target size range for the one release group was 52.3%.

The number of Chinook salmon in the three release groups with adipose finclips and coded wire tags was obtained during tagging. Hatchery inventory methods were used to estimate the number of all seven coho salmon release groups and seven Chinook salmon release groups that did not receive adipose finclips and coded wire tags.

Key words: hatchery, adipose clip, coded wire tags, thermal marking, otolith, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, tag retention, size composition.

## INTRODUCTION

Southcentral Alaska receives the vast majority of the state's sport fishing effort (Jennings et al. 2009). Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* smolt reared at Fort Richardson Hatchery (FRH) and Elmendorf Hatchery have been stocked in numerous locations throughout Southcentral Alaska to improve or create terminal sport fisheries and relieve pressure on wild stocks (Appendices A1 and A2). One element of the coho and Chinook salmon hatchery smolt stocking projects in Cook Inlet, Prince William Sound, and Resurrection Bay is the use of thermal marks (TM) to identify fish. Some salmon smolt are also marked with an adipose finclip and a coded wire tag (CWT). TMs and CWTs can be used to estimate the contribution of hatchery stockings to commercial fisheries, marine and freshwater recreational fisheries, and personal use fisheries. They can also be used to estimate spawning escapement in stocked streams, and estimate straying of stocked coho and Chinook salmon.

The accuracy of hatchery contribution estimates from CWT recoveries is highly dependent upon the accuracy of the estimated number of unmarked fish in the release groups. Estimating the number of unmarked fish is not needed when using TMs because all fish are marked. However, determining the number of fish in each release group is still necessary. The methods used at FRH for determining the number of unmarked fish and/or total number of fish in release groups include a tagging inventory (TI) count, a hatchery inventory (HI) estimate, and a water volume displacement (WV) estimate.

Another important element of hatchery smolt stocking programs is fish size. Weight and length of smolt at release are indicators of quality (Peltz and Starkey 1993). If smolt are too small at release, then ocean survival will be poor; and if smolt are too large at release, then ocean residence will be reduced, thus shifting age composition of returns to younger, smaller fish (Sweet and Peltz 1994). To maximize ocean survival of hatchery smolt and maintain the age composition of an existing population, Peltz and Starkey (1993) recommend that 80% of smolt released weigh between 15.1 g and 25.0 g for coho salmon and between 5.1 g and 15.0 g for Chinook salmon.

This project documented the release of Chinook and coho salmon with TMs and CWTs in Cook Inlet, Prince William Sound, and Resurrection Bay in 2007. There are three specific objectives for this project:

1. To estimate the long-term (>30 days) tag retention rate and adipose finclip quality of each smolt release group marked with CWTs;
2. To verify the thermal mark applied to otoliths in each coho and Chinook salmon smolt release group;
3. To estimate the weight distribution of each smolt release group marked with CWTs.

One goal was to mark all Chinook salmon in three release groups with an adipose finclip and a CWT. A second goal was to mark all fish with a thermal mark.

A task associated with this project was to compare smolt abundance estimates using the HI and WV methods to the TI count for all Chinook salmon release groups marked with an adipose finclip and a CWT.

Included in this report are recommendations for future marking and collecting of smolt release data. All data for this report are held and archived by Research and Technical Services, Division of Sport Fish, Alaska Department of Fish and Game (ADF&G).

## **METHODS**

Coho salmon broodstock from Bear Lake, Ship Creek (Little Susitna River), and Eklutna Tailrace (Jim Creek) were raised at FRH. Chinook salmon broodstock from Deception Creek, Ship Creek, Crooked Creek, and Ninilchik River were also raised at FRH. Fish from 17 release groups were stocked at 10 locations in Cook Inlet, 2 locations in Prince William Sound, and 2 locations in Resurrection Bay (Table 1).

### **SMOLT MARKING**

#### **Coded Wire Tagging**

All Chinook salmon smolt in three release groups were adipose clipped and injected with a CWT (Table 2). Unique tag codes were used for each release group marked with CWTs.

To determine which head mold sizes would provide the best tag placement, approximately 100 fish from each of the three broodstocks were measured to fork length (to the nearest millimeter) within 7 days of tagging. Two or three head mold sizes that fit at least 80% of the length distribution were selected for tagging (Peltz and Hansen 1994). All fish were graded and tagged accordingly with a full-length CWT (1.1 mm) using a Northwest Marine Technology<sup>1</sup> Mark IV tag injector.

Fish were anesthetized with MS-222 before tagging. The adipose fin was excised at the base using surgical scissors. Tags were then injected into the noses of the fish, and the fish were sent through a Quality Control Device (QCD). The QCD detected the magnetized tag and separated the fish with tags from those without tags. All fish without tags were injected again. Quality control checks for tag placement were conducted following initial daily startup, and following a change in head mold size or a change in tagging personnel. During each quality control check, a

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<sup>1</sup> Use of a company's name does not constitute endorsement.



Table 1.-Total number of fish released at 14 locations in Cook Inlet, Prince William Sound, and Resurrection Bay in 2007.

Release area	Release location	Broodstock	Inventory method used	Number of fish in release group
<b><u>Chinook salmon</u></b>				
Cook Inlet	Crooked Creek	Crooked Creek	tagging inventory	111,382
Cook Inlet	Deception Creek	Deception Creek	tagging inventory	103,016
Cook Inlet	Eklutna Tailrace	Ship Creek	hatchery inventory	110,978
Cook Inlet	Halibut Cove	Ninilchik River	hatchery inventory	54,560
Cook Inlet	Homer Spit	Ninilchik River	hatchery inventory	226,972
Cook Inlet	Ninilchik River	Ninilchik River	tagging inventory	56,325
Cook Inlet	Seldovia	Ninilchik River	hatchery inventory	54,276
Cook Inlet	Ship Creek	Ship Creek	hatchery inventory	333,940
Prince William Sound	Fleming Spit	Deception Creek	hatchery inventory	119,860
Prince William Sound	Valdez, Old Town Site	Deception Creek	hatchery inventory	126,241
<b><u>Coho salmon</u></b>				
Cook Inlet	Bird Creek	Ship Cr (Little Susitna River)	hatchery inventory	104,979
Cook Inlet	Campbell Creek	Ship Cr (Little Susitna River)	hatchery inventory	82,794
Cook Inlet	Eklutna Tailrace	Eklutna Tailrace (Jim Creek)	hatchery inventory	118,054
Cook Inlet	Homer Spit	Ship Cr (Little Susitna River)	hatchery inventory	127,244
Cook Inlet	Ship Creek	Ship Cr (Little Susitna River)	hatchery inventory	255,400
Resurrection Bay	Lowell Creek	Bear Lake	hatchery inventory	130,682
Resurrection Bay	Seward Lagoon	Bear Lake	hatchery inventory	132,811
Total				2,249,514

minimum of two tagged fish were dissected to determine tag placement (Moberly et al. 1977; Figure 1). Head mold or wire placement adjustments were made when necessary. The fish dissected to determine tag placement were not included in the tagged fish counts.

After tagging, all fish were held in net pens overnight to determine short-term mortality and short-term tag retention rates. All overnight mortalities were counted and recorded. Short-term retention rates were estimated daily by passing a random sample of 200 fish through the QCD. Daily tag retention rate ( $D_i$ ) of surviving smolt was estimated as a binomial proportion:

$$\hat{D}_i = \frac{n_i}{n_{ti}}, \quad (1)$$

where:

- $n_i$  = number of live smolt in the sample tagged on day  $i$  that retained the tag, and
- $n_{ti}$  = total number of live smolt in the sample tagged on day  $i$ ,

Table 2.-Summary of coded wire tagging data and smolt abundance estimates for Chinook salmon released in Cook Inlet, 2007.

Release location parameter	Chinook salmon			Totals
	Deception Creek	Ninilchik River	Crooked Creek	
Tag codes	310367 310326	310366	310368 310352	
Initial number of fish with an adipose finclip and CWT	104,452	56,485	115,497	276,434
Pre-release mortalities	1,436	160	810	2,406
Transport/holding mortalities	N/A	N/A	3,305	3,305
Acceptable adipose finclips	100.0%	99.5%	100.0%	
Adipose-clipped fish released	103,016	56,037	111,382	270,435
Tag retention sample size	800	782	763	
Tag retention at release	100.0%	99.7%	99.9%	100.0%
Tag retention variance	0	3.26633E-06	1.7177E-06	
Tagged fish released	103,016	56,156	111,271	270,443
Tagged fish variance	-	10,257	21,310	
Total fish released	103,016	56,325	111,382	270,723
Tagging dates	3/19/2007 4/5/2007	4/6/2007 4/18/2007	2/5/2007 3/16/2007	
Date of tag retention check	5/29/2007	5/14/2007	5/31/2007	
Days elapsed	54	26	76	

and a variance of:

$$Var(\hat{D}_i) = \frac{\hat{D}_i(1 - \hat{D}_i)}{n_{ti} - 1}. \quad (2)$$

Fish checked for overnight tag retention were also examined for adipose finclip quality. At least 80% fin removal was required for the clip to be acceptable.

Tagged smolt were transferred to a rearing unit (raceway) following overnight mortality checks and held until release. Fish mortality was monitored daily and all mortalities were recorded.

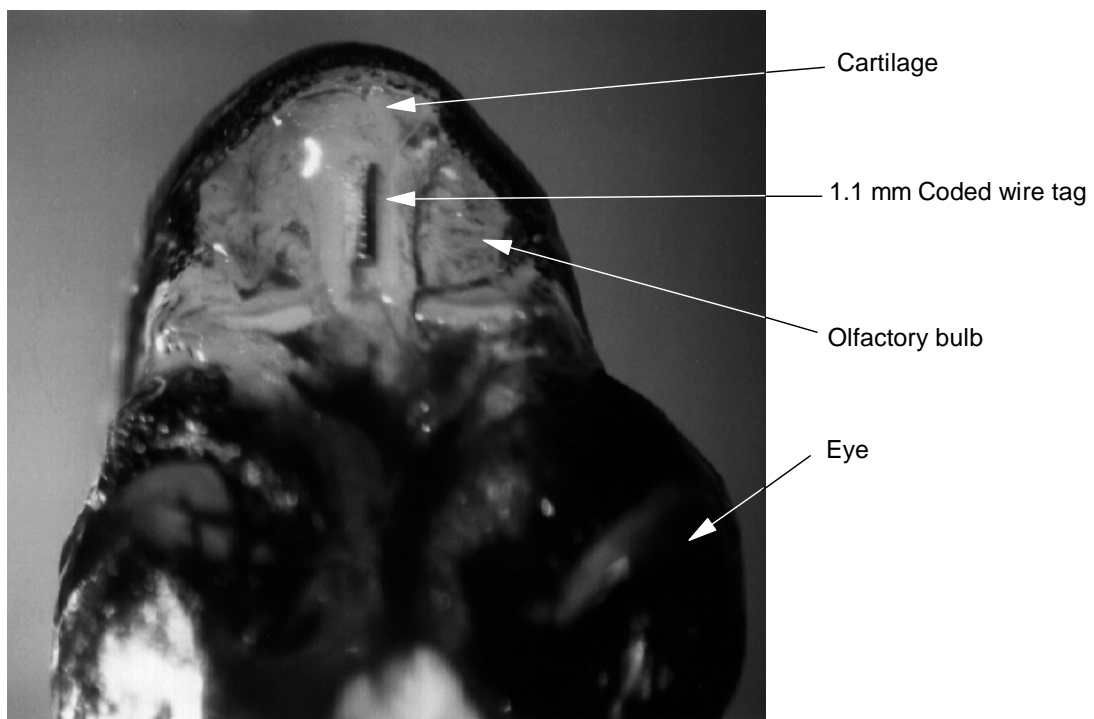
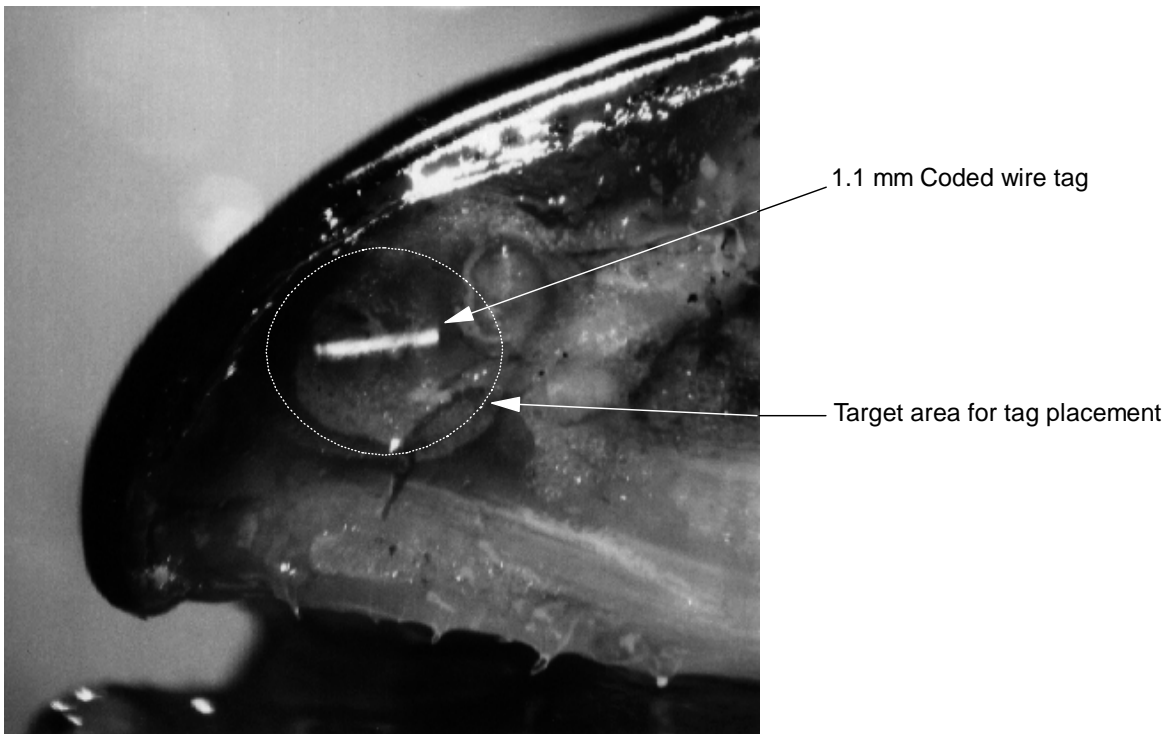


Figure 1.-Proper placement of a coded wire tag in a small fish.

Long-term tag retention was estimated for all release groups at least 30 days after tagging (Blankenship 1990). At least 750 adipose-clipped fish were randomly sampled from the population and checked for tag retention using a hand-held CWT detector. Long-term tag retention rate ( $D_j$ ) of surviving smolt, and its variance, was also estimated as a binomial proportion (equations 1 and 2) for each release group,

where:

$$\begin{aligned} n_i &= \text{number of smolt in the sample that retained the tag; and} \\ n_{ti} &= \text{total number of tagged smolt in the sample.} \end{aligned}$$

The number of fish released with CWTs ( $\hat{T}_j$ ) was estimated as:

$$\hat{T}_j = (N_j - M_j) \hat{D}_j, \quad (3)$$

and its variance as:

$$\text{Var}(\hat{T}_j) = (N_j - M_j)^2 \text{Var}(\hat{D}_j), \quad (4)$$

where:

$$\begin{aligned} N_j &= \text{number of fish injected with a tag in group } j, \\ \hat{D}_j &= \text{long-term tag retention of release group } j, \text{ and} \\ M_j &= \text{total number of mortalities of tagged fish in group } j. \end{aligned}$$

A minimum of 750 smolt per rearing unit was examined for adipose finclip quality within 7 days of release. Adipose finclips were rated as acceptable or not acceptable. An acceptable rating was given to those with at least 80% of the adipose fin removed.

### Thermal Marking

Thermal marks were applied to all coho and Chinook salmon embryos before hatching. Thermal mark patterns were assigned by the Mark, Tag, and Age Laboratory operated by ADF&G, Division of Commercial Fisheries (Table 3). At approximately 310 cumulative temperature units (CTUs) for coho salmon and 360 CTUs for Chinook salmon, otoliths were developed enough to accept a mark, as verified by the Mark, Tag, and Age Laboratory. Embryos were exposed to a series of 4-5°C water temperature changes (both increases and decreases), with each temperature decrease resulting in the deposit of a dark protein ring on the developing otolith (Monk *Unpublished*)<sup>2</sup>. Water temperature changes were scheduled every 24 hours, with a 72-hour warmwater exposure occurring between bands of rings for Chinook salmon. The assigned patterns of dark protein rings applied to the otoliths (Figure 2) are used to identify the area of release from returning adult salmon. Onset Stowaway XTI data loggers recorded incubation water temperature every 15 minutes throughout the marking period to generate thermal profiles for each mark type (Figure 3).

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<sup>2</sup> Monk, K. M. *Unpublished*. Thermal marking manual: A guideline to the induction of thermal marks in otoliths for the purpose of mass marking hatchery stocks. Located at Alaska Department of Fish and Game, Division of Commercial Fisheries, Mark, Tag, and Age Laboratory, 10107 Bentwood Place, Juneau, Alaska 99802-5526.

Table 3.-Summary of Chinook salmon and coho salmon thermal marks (hatch codes) for smolt released at 10 locations in Cook Inlet, 2 locations in Prince William Sound, and 2 locations in Resurrection Bay in 2007.

Release area mark group(s)	Release location	Hatch code(s)
<b><u>Chinook salmon</u></b>		
Cook Inlet	Crooked Creek	2,3H <sup>a</sup>
Cook Inlet	Deception Creek	2,3H <sup>a</sup>
Cook Inlet	Eklutna Tailrace	2,3H <sup>a</sup>
Cook Inlet	Ship Creek	2,3H <sup>a</sup>
Cook Inlet	Halibut Cove	2,3H <sup>a</sup>
Cook Inlet	Homer Spit	2,3H <sup>a</sup>
Cook Inlet	Ninilchik River	2,3H <sup>a</sup>
Cook Inlet	Seldovia	2,3H <sup>a</sup>
Prince William Sound	Fleming Spit	2,4H
Prince William Sound	Valdez Harbor	2,4H
<b><u>Coho salmon</u></b>		
Cook Inlet	Bird Creek	1,5H
Cook Inlet	Campbell Creek	1,5H
Cook Inlet	Eklutna Tailrace	1,5H
Cook Inlet	Homer Spit	1,5H
Cook Inlet	Ship Creek	1,5H
Resurrection Bay	Lowell Creek	2,4H
Resurrection Bay	Seward Lagoon	2,4H

<sup>a</sup> Some lots with the Cook Inlet TM have an extra ring following the secondary band causing the TM to appear as a 2,4H.

Voucher samples containing approximately 50 fish from each egg lot were collected before moving fish to the raceways (ponding) and submitted to the Mark, Tag, and Age Laboratory for mark verification.

### **Coho Salmon**

Coho salmon were thermally marked in 2005. Different TMs consisting of 2 bands were applied to identify the fish as belonging to a Cook Inlet release group (1 band of 1 ring followed by 1 band of 5 rings, or 1,5H) or a Resurrection Bay release group (1 band of 2 rings followed by 1 band of 4 rings, or 2,4H) (Table 3). Thermal marking was completed before hatching occurred.

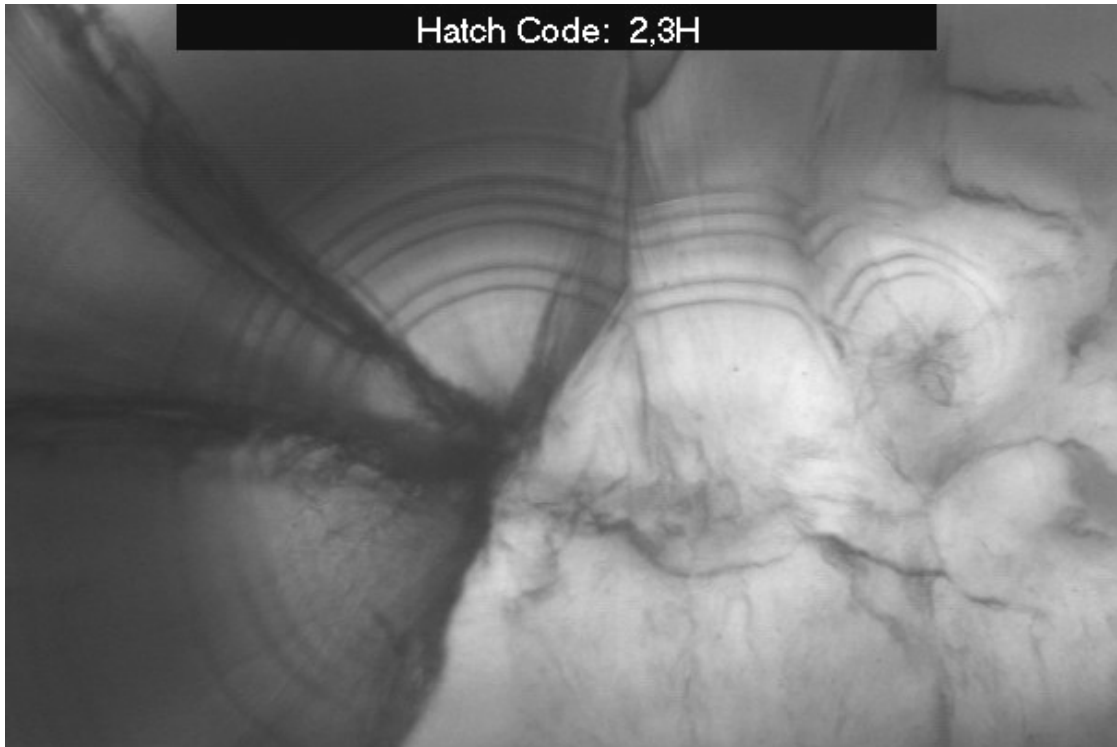


Figure 2.-Image of a thermal mark applied to Chinook salmon released in Cook Inlet, 2007.

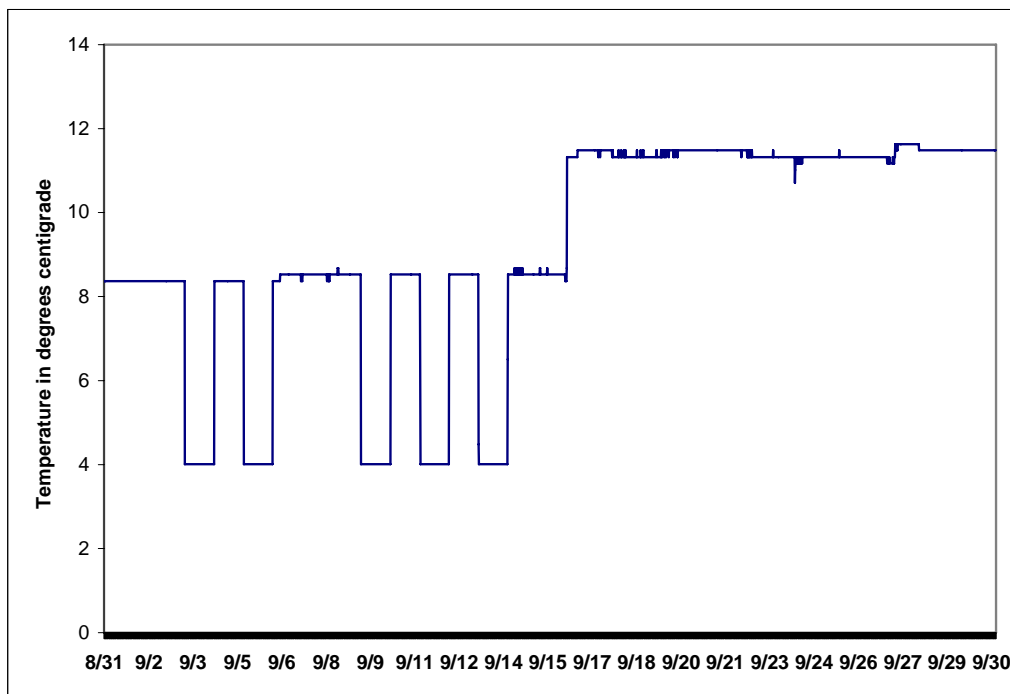


Figure 3.-Thermal marking temperature profile for Chinook salmon released into Cook Inlet in 2007 with a thermal mark (hatch code) of 2,3H.

## **Chinook Salmon**

Chinook salmon were thermally marked in 2005. Different TMs consisting of 2 bands were applied to identify the fish as belonging to a Cook Inlet release group (2,3H) or a Prince William Sound release group (2,4H) (Table 3). The first band consisted of 2 rings for all Chinook salmon release groups, and the second band consisted of 3 rings for Cook Inlet and 4 for Prince William Sound release groups.

## **SMOLT ENUMERATION**

The number of fish in all 17 release groups was obtained (before release) using the TI count, HI abundance estimate, and/or the WV abundance estimate. The TI counts were compared to the HI and WV estimates to determine the precision of the HI and WV estimates. If the HI or WV estimates differed by more than 10% from the TI count, the estimates were reviewed to determine the cause of the discrepancy and determine which technique provided the most appropriate estimate.

## **Tagging Inventory**

A TI count was obtained from the tag counter on the Mark IV CWT injector for the three Chinook salmon release groups 100% injected with CWTs. Thus, the number of injected tags equaled the number of fish in a release group. For these release groups, fish mortality was monitored daily and subtracted from the original TI count to yield a final fish count for each release group.

## **Hatchery Inventory Estimates**

The HI abundance technique used at FRH was based on the weight of fish in a raceway. These estimates were obtained when fingerling were moved from small indoor raceways to large outdoor raceways. Approximately 10 randomly selected net loads of fish were used to estimate mean fish weight. Because a net full of fish was too large to enumerate (approximately 600-800 fish), the net was manually halved numerous times until 50-100 fish remained in the net. These fish were weighed and hand counted from a bucket to determine mean fish weight. The total weight of fish, obtained using the accumulative weight feature on the electronic scale, was then divided by the mean fish weight to establish the HI abundance estimate in that raceway. The number of fish released equaled the original outdoor raceway estimate minus the fish stocked or transferred, minus the mortalities in the outdoor raceway, and minus mortalities that occurred during transport or while the fish were held at the release site for imprinting.

## **Volumetric Estimates**

Fish abundance (number and weight) was also estimated volumetrically using a transport tank when transporting fish to the release site. This estimate is a function of the tank volume (gallons), the ratio of the volume of water displaced in the tank sight gauge to the volume of water placed in the tank (mm/gallon), and the ratio of the number (or weight) of fish which displace a volume of water in the tank sight gauge (fish/mm or kg/mm).

For fish transport, each tank was filled with water and the water level on the tank sight gauge recorded to the nearest millimeter. Fish were then pumped from the raceway into each of the transport tanks. The water level on the tank gauge was recorded again after fish were loaded into each of the tanks. The millimeters of water displaced for each tank were determined, and using a known displacement value of kilograms of fish per millimeter, the total weight of fish in the tank

was estimated. Total number of fish was estimated by dividing the total fish weight by the mean fish weight.

FRH estimated mean weight by obtaining fish samples from five nets of fish before loading the tanks. Each net of fish was split in half several times until the desired sample size (50-100 fish) was achieved. The fish were poured into a pre-weighed bucket of water, weighed to the nearest gram, and counted out of the bucket. Mean weight was calculated for each of the five samples, and an overall mean weight was calculated by summing the five sample mean weights and dividing by five.

## **SIZE ESTIMATION**

A sample of fish from each Chinook salmon raceway containing CWTs and one raceway of coho salmon were individually weighed and measured. Fish were crowded to one end of a raceway and a minimum of 510 fish were dipnetted and put into a small holding pen. Each fish sampled from the holding pen was measured to the nearest millimeter and weighed to the nearest 0.1 g.

# **RESULTS**

## **SMOLT MARKING**

### **Coded Wire Tagging**

There were 270,723 Chinook salmon smolt released with an adipose finclip and a CWT in Cook Inlet in 2007 (Table 2). The goal of marking 100% of the Chinook salmon in three release groups with an adipose finclip and a CWT was achieved.

Long-term tag retention was determined 26-76 days after tagging (Table 2). Tag retention rates ranged from 99.7% to 100.0%. Adipose finclip quality ranged from 99.5% to 100%.

### **Thermal Marking**

TM digital images and thermal profiles indicated that all Chinook and coho salmon release groups were marked with their assigned TM. However, some Cook Inlet TM Chinook salmon egg lots have an extra ring following the secondary band (appears like a 2,4H TM) (Table 3). This extra ring will require careful grinding of the otoliths to prevent misidentifying the area of release for returning adult salmon.

## **SMOLT RELEASES**

All 17 coho and Chinook salmon release groups were stocked in Cook Inlet, Prince William Sound, and Resurrection Bay release areas in 2007 (Table 1). FRH released an estimated 951,964 coho salmon smolt at 7 locations and an estimated 1,297,550 Chinook salmon smolt at 10 locations (Table 1).

## **SMOLT ENUMERATION**

HI estimates were reported for all 7 coho salmon and 7 of the 10 Chinook salmon release groups (Table 1). TI counts were reported and compared to the results of HI and WV estimates for the three TI Chinook salmon release groups. The HI estimates were within 4.8% of the TI counts and the WV estimates were within 9.3% of the TI counts (Table 4).

## **SIZE ESTIMATION**

The production goal of having 80% of coho salmon weigh between 15.1 and 25.0 g at the time of release was not achieved for the one release group sampled (52.3%; Table 5; Figure 4). An estimated 32.6% were up to 5 g smaller than the production goal, and an estimated 14.1% were



Table 4.-A comparison of hatchery inventory and water volume population estimates to a tagging inventory count for three release groups of Chinook salmon reared at Fort Richardson Hatchery.

Estimation technique	Fort Richardson		
	Deception Cr	Ninilchik R	Crooked Cr <sup>a</sup>
Post-transport/holding			
Tagging inventory	103,016	56,325	111,382
Hatchery inventory	108,262	56,368	111,695
Displacement	108,463	62,115	111,072
Difference TI to HI	4.8%	0.1%	0.3%
Difference TI to WV	5.0%	9.3%	-0.3%
Difference HI to WV	0.2%	9.3%	-0.6%

<sup>a</sup> 3,305 transportation and holding mortalities have been subtracted from each inventory estimate.

Table 5.-The percentage of Chinook salmon in CWT release groups and coho salmon in one non-CWT release group from Fort Richardson Hatchery in 2007 that are within, smaller than, and larger than the production goal's target size range.

Release group	Percent		
	Below	Within	Above
<b>Coho salmon<sup>a</sup></b>			
Ship Creek	46.7%	52.3%	1.0%
<b>Chinook salmon<sup>b</sup></b>			
Deception Creek	0.4%	98.3%	1.3%
Ninilchik River	1.4%	98.5%	0.2%
Crooked Creek	0.0%	96.7%	3.3%

<sup>a</sup> Production goal for coho salmon: 80% of smolt 15.1-25.0 g.

<sup>b</sup> Production goal for Chinook salmon: 80% of smolt 5.1-15.0 g.

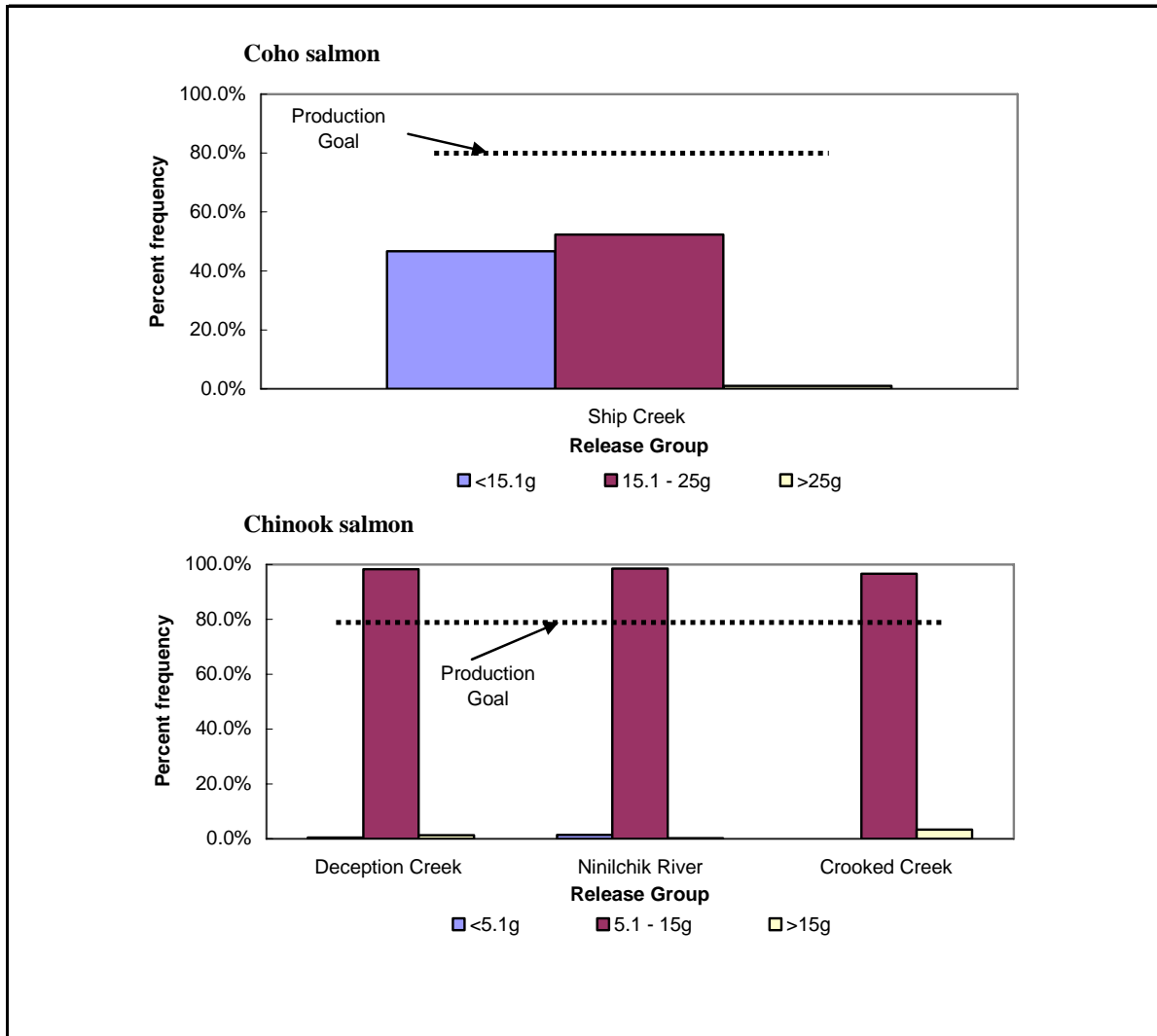


Figure 4.-Weight distributions, mean weights, and production goal target weight range for coho and Chinook salmon reared at Fort Richardson Hatchery and released in 2007.

more than 5 g smaller than the production goal. The production goal for Chinook salmon was to have 80% of the fish weigh between 5.1 and 15.0 g at the time of release. All three Chinook salmon release groups achieved the production goal (Ninilchik River = 98.5%, Deception Creek = 98.3%, Crooked Creek = 96.7%) (Table 5; Figure 4).

## DISCUSSION

### SMOLT MARKING

#### Coded Wire Tagging

A point of emphasis for the CWT marking program has been to achieve good long-term CWT retention rates. Overall long-term tag retention in 2007 was 99.9% (Table 2). Grading fish and using different sizes of head molds for tagging is responsible for maintaining acceptable (>97%) long-term tag retention rates.

The minimum recommended elapsed time between tagging and estimating long-term CWT retention is 30 days. Cold weather and ice-covered raceways forced a 2-week delay in tagging. This resulted in an elapsed time for the Ninilchik River release group of only 26 days. Freshwater release sites like Ninilchik River are the first sites stocked because any Chinook salmon that has not completed smolting can do so in the river and move into salt water on its own. Chinook salmon released directly into salt water may be reared at the hatchery an additional 1 to 2 weeks to increase the proportion of fish in the release group that are smolt. Approximately 71% of the smolt in the Ninilchik River release group was tagged at least 30 days before pre-release sampling. Therefore, a substantial difference in the long-term CWT retention rate for the Ninilchik River release group is unlikely.

### **Thermal marking**

Voucher samples indicate that Chinook salmon smolt released into Cook Inlet sites may have an extra ring following the secondary band causing the TM to appear as a 2,4H. The cause of this ring is unknown and these otoliths could be mistaken for otoliths from Prince William Sound releases. However, the Mark, Tag, and Age lab noted that careful otolith preparation reveals the correct Cook Inlet mark and minimizes the risk of an erroneous otolith reading.

### **SMOLT ENUMERATION**

The WV and HI estimates were within 10% of the TI count for each of the 3 raceways of tagged fish. Therefore, further review of the estimation techniques was not necessary.

### **SIZE ESTIMATION**

To maximize ocean survival and maintain the age composition of the population, Peltz and Starkey (1993) recommend that 80% of hatchery coho smolt weigh between 15.1 and 25.0 g, and hatchery Chinook salmon weigh between 5.1 and 15.0 g at time of release. Cold weather in February and March produced a thick layer (up to 6 inches) of ice on the surface of the coho and Chinook salmon raceways, making feeding impossible for over a month and inhibiting fish growth. The decrease in winter growth contributed to a higher percentage (46.7%) of undersized coho salmon than the previous two release years (2004 = 15.3%; 2005 = 11.2%), possibly having a negative effect on ocean survival (Loopstra and Hansen 2007). The decrease in winter growth may have helped the Chinook salmon release groups (percentage of fish that achieved the production goal: Deception Creek = 98.3%, Ninilchik River = 98.5%, Crooked Creek = 96.7%). At least 10% of the sampled Chinook salmon in 2004 and 2005 was larger than the production goal (Loopstra and Hansen 2007, 2008). The Chinook salmon size at release in 2007 may increase ocean survival and shift the age composition of returning adults to older, larger fish compared to the adult returns from the 2004 and 2005 releases.

## **RECOMMENDATIONS**

1. All fish should be graded and tagged using the appropriate head mold sizes.
2. Take care in tag placement to increase or maintain acceptable long-term retention rates.
3. Temperature changes of 4–5°C should occur every 24 hours between rings, and every 72 hours between bands of rings during thermal marking.
4. Follow the production goal recommendations that 80% of coho salmon smolt released weigh between 15.1 g and 25.0 g, and 80% of Chinook salmon smolt weigh between 5.1 g and 15.0 g.

5. Record individual bucket weights when determining hatchery inventory estimates in case of electronic scale failure.
6. Wait a minimum of 30 days after tagging before determining long-term tag retention rate.

## **ACKNOWLEDGMENTS**

We would like to thank Andrea Tesch and the staff at Fort Richardson Hatchery for their help and cooperation during thermal marking and coded wire tagging operations. We would also like to thank the members of the tagging crew for performing an excellent job while dealing with inclement weather.

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## **APPENDIX A.**

Appendix A1.-Historical releases of coho salmon that were adipose clipped and tagged with coded wire tags, and/or thermally marked.

					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged			
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Fish Released	Fish Released	Percent tagged	Mark Group	Hatch Code
<b>Anchorage Urban Streams<sup>b</sup></b>											
1994	Little Susitna	Ft Richardson	1996	31-25-06	302,857	M-R	93,975	92,565	30.56%		
<b>Bird Creek</b>											
1990	Little Susitna	Ft Richardson	1992	31-20-02, 03	95,377	M-R	44,903	37,629	39.50%		
1991	Little Susitna	Ft Richardson	1993	31-21-39	140,382	M-R	43,441	42,350	30.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-02	84,643	M-R	45,220	44,686	52.80%		
1993	Little Susitna	Ft Richardson	1995	31-23-37	154,753	M-R	45,666	45,490	29.40%		
1994	Little Susitna	Ft Richardson	1996	31-25-04	147,618	M-R	46,528	45,411	30.80%		
1995	Little Susitna	Ft Richardson	1997	31-26-01	146,612	HI	45,901	45,488	31.03%		
1995	Little Susitna	Ft Richardson	1997	31-26-27	147,953	HI	45,836	45,469	30.73%		
1996	Little Susitna	Ft Richardson	1998	31-26-25	164,211	HI	46,140	46,094	28.07%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-15	111,430	EC	37,344	36,746	32.98%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-43	97,409	EC	40,114	39,392	40.44%		
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		109,949	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 <sup>c</sup>		100,605	HI					
2004	Ship Cr (Little Susitna)	Ft Richardson	2006		104,974	HI				Cook Inlet	5H
2005	Ship Cr (Little Susitna)	Ft Richardson	2007		104,979	HI				Cook Inlet	1,5H
<b>Campbell Creek<sup>b</sup></b>											
1990	Little Susitna	Ft Richardson	1992	31-20-04 31-20-05	97,076	M-R	43,681	39,444	40.60%		
1991	Little Susitna	Ft Richardson	1993	31-21-38	140,797	M-R	43,440	42,916	30.50%		
1992	Little Susitna	Ft Richardson	1994	31-23-03	87,686	M-R	44,144	42,963	49.00%		
1993	Little Susitna	Ft Richardson	1995	31-23-36	157,241	M-R	45,655	44,995	28.60%		
1995	Little Susitna	Ft Richardson	1997	31-25-62	71,519	TI	45,840	45,290	63.33%		
1996	Little Susitna	Ft Richardson	1998	31-26-52	83,317	HI	22,453	22,296	26.76%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-01-30	42,046	EC	20,879	20,378	48.47%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-02-30	63,730	EC	19,948	19,549	30.67%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-32	69,836	HI	21,568	20,813	29.80%		

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged		Mark	Hatch
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Fish Released	Fish Released	Percent tagged	Group	Code
<b>Campbell Creek<sup>b</sup> (continued)</b>											
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-97	61,323	HI	22,789	21,672	35.34%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		78,576	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		85,790	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 <sup>c</sup>		60,387	HI					
2004	Ship Cr (Little Susitna)	Ft Richardson	2006		78,405	HI				Cook Inlet	5H
2005	Ship Cr (Little Susitna)	Ft Richardson	2007		82,794	HI				Cook Inlet	1,5H
<b>Cottonwood Creek</b>											
1990	Fish Creek	Big Lake	1992	31-20-08 31-21-09	53,900	M-R	35,341	32,938	61.10%		
1991	Fish Creek	Big Lake	1993	31-21-41	74,198	M-R	43,117	40,875	55.10%		
<b>Eklutna Tailrace</b>											
1996	Jim Creek	Ft Richardson	1998	31-26-27 31-26-54, 55,56	112,219	TI	112,219	111,882	99.70%		
1997	Jim Creek	Ft Richardson	1999	31-26-16	126,602	EC	44,073	42,663	33.70%		
1998	Jim Creek	Ft Richardson	2000	31-01-46	76,851	EC	40,514	40,149	52.24%		
1999	Eklutna Tailrace	Ft Richardson	2001	31-02-47	124,838	HI	43,713	43,494	34.84%		
2000	Eklutna Tailrace	Ft Richardson	2002	31-02-46	120,629	HI	44,518	44,295	36.72%	Cook Inlet	5H
2001	Eklutna Tailrace	Ft Richardson	2003		120,736	HI				Cook Inlet	5H
2002	Eklutna Tailrace	Ft Richardson	2004		131,979	HI				Cook Inlet	5H
2003	Eklutna Tailrace	Ft Richardson	2005 <sup>c</sup>		132,149	HI					
2004	Eklutna Tailrace	Ft Richardson	2006		132,212	HI				Cook Inlet	5H
2005	Eklutna Tailrace	Ft Richardson	2007		118,054	HI				Cook Inlet	1,5H

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged		Mark	Hatch
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Released	Fish Released	Percent tagged	Group	Code
<b>Fish Creek</b>											
1990	Fish Creek	Big Lake	1992	31-20-12	74,953	M-R	45,538	43,625	58.20%		
				31-20-13							
1991	Fish Creek	Big Lake	1993	31-21-40	67,934	M-R	44,050	43,257	63.70%		
<b>Homer Spit</b>											
1996	Bear Lake	Elmendorf	1998	31-26-28	130,219	M-R	42,057	41,926	32.20%		
1997	Bear Lake	Elmendorf	1999	31-01-40	129,602	M-R	44,405	43,020	33.19%		
	Bear Lake	Elmendorf/ Ft Richardson	2000-01 <sup>c</sup>								
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-01-36	100,280	HI	44,992	44,812	44.69%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-98	95,648	HI	45,498	44,179	46.19%	Cook Inlet	5H
2000	Bear Lake	Ft Richardson	2002		120,707	HI				Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		222,935	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		130,243	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 <sup>c</sup>		125,707	HI					
2004	Ship Cr (Little Susitna)	Ft Richardson	2006		125,216	HI				Cook Inlet	5H
2005	Ship Cr (Little Susitna)	Ft Richardson	2007		127,244	HI				Cook Inlet	1,5H
<b>Little Susitna at Houston</b>											
1990	Little Susitna	Ft Richardson	1992	31-20-07	154,466	M-R	21,884	19,564	12.70%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	148,282	M-R	21,404	20,312	13.70%		
<b>Lowell Creek</b>											
2000	Bear Lake	Ft Richardson	2002		119,512	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		124,389	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,989	HI				Resurrection Bay	4H
2003	Bear Lake	Ft Richardson	2005 <sup>c</sup>		132,276	HI					
2004	Bear Lake	Ft Richardson	2006		131,261	HI				Resurrection Bay	4H
2005	Bear Lake	Ft Richardson	2007		130,682	HI				Resurrection Bay	2,4H

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Brood		Hatchery	Release		Total Released		Coded Wire Tagged			Thermal Marking	
					Estimate	Type of Estimate <sup>a</sup>	Clipped Fish Released	Tagged Fish Released	Percent tagged	Mark Group	Hatch Code
Year	Brood stock		Year	CWT Code							
<b>Nancy Lake</b>											
1990	Little Susitna	Ft Richardson	1992	31-20-06	158,459	M-R	21,598	19,222	12.10%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	131,591	M-R	21,001	19,930	15.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-01	126,694	M-R	44,489	43,818	34.60%		
1993	Little Susitna	Ft Richardson	1995	31-23-39	151,985	M-R	46,261	45,245	29.80%		
<b>Seward Lagoon</b>											
2000	Bear Lake	Ft Richardson	2002		121,743	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		123,718	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,798	HI				Resurrection Bay	4H
2003	Bear Lake	Ft Richardson	2005 <sup>c</sup>		132,229	HI					
2004	Bear Lake	Ft Richardson	2006		131,326	HI				Resurrection Bay	4H
2005	Bear Lake	Ft Richardson	2007		132,811	HI				Resurrection Bay	2,4H
<b>Ship Creek<sup>b</sup></b>											
1990	Ship Creek	Elmendorf	1992	31-19-63 31-20-01	67,178	TI	44,086	38,443	57.20%		
1991	Ship Creek	Elmendorf	1993	31-21-36	54,764	PC	42,112	41,322	75.50%		
1992	Ship Creek	Elmendorf	1994	31-23-04	75,779	PC	44,031	41,722	55.10%		
1993	Little Susitna	Ft Richardson	1995	31-23-38	158,981	M-R	45,491	44,654	28.10%		
1995	Little Susitna	Ft Richardson	1997	31-25-63	232,066	TI,HI	45,925	45,741	19.71%		
1996	Little Susitna	Ft Richardson	1998	31-26-53 31-26-26	232,765	HI	67,812	66,997	28.78%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-14 31-01-29	165,388	EC	48,299	45,380	27.44%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-32 31-01-33	260,070	EC	61,640	58,989	22.68%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-61	233,563	HI	64,165	61,663	26.40%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-02-83	212,639	HI	67,959	63,678	29.95%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003	31-02-74, 31-02-69	234,716	HI	64,234	64,125	27.32%	Cook Inlet	5H

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood Year	Brood stock	Hatchery	Release Year	CWT Code	Estimate	Type of Estimate <sup>a</sup>	Clipped Fish Released	Tagged Fish Released	Percent tagged	Mark Group	Hatch Code
<b>Ship Creek<sup>b</sup> (continued)</b>											
2002	Ship Cr (Little Susitna)	Ft Richardson	2004	31-02-81, 31-03-15	241,066	HI	63,222	62,906	26.09%	Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 <sup>c</sup>		251,446	HI					
2004	Ship Cr (Little Susitna)	Ft Richardson	2006		252,775	HI				Cook Inlet	5H
2005	Ship Cr (Little Susitna)	Ft Richardson	2007		255,400	HI				Cook Inlet	1,5H
<b>Wasilla Creek</b>											
1990	Fish Cr	Big Lake	1992	31-20-10 31-20-11	76,315	M-R	44,148	41,985	55.00%		
1991	Fish Cr	Big Lake	1992	31-21-42	77,174	M-R	43,001	41,711	54.10%		
1994	Little Susitna	Ft Richardson	1996	31-25-05	145,923	M-R	46,980	46,839	32.10%		

<sup>a</sup> M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory estimate; EC is electronic count;

<sup>b</sup> Campbell and Ship creeks were combined and termed "Anchorage Urban Streams" in 1996.

<sup>c</sup> Stocking continued, but releases did not contain tagged or thermally marked fish.

Appendix A2.-Historical releases of Chinook salmon that were adipose clipped and tagged with coded wire tags, and/or thermally marked.

					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged			
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Fish Released <sup>b</sup>	Fish Released	Percent Tagged	Mark Group	Hatch Code
Buskin River											
1994	Deception Cr	Elmendorf	1995	31-24-31	84,349	M-R	41,572	41,078	48.70%		
1995	Deception Cr	Elmendorf	1996	31-25-09	113220	M-R	41259	40681	35.90%		
Crooked Creek											
1993	Crooked Cr	Elmendorf	1994	31-23-14	224,784	M-R	43,609	43,034	19.10%		
1994	Homer (Crooked Cr)	Elmendorf	1995	31-24-27	184,049	M-R	40,903	38,420	20.90%		
1995	Homer (Crooked Cr)	Elmendorf	1996	31-25-12	193,180	M-R	40,827	40,196	20.80%		
1996	Homer (Crooked Cr)	Elmendorf	1997	31-25-55	223,200	M-R	41,049	39,038	17.49%		
1997	Homer (Crooked Cr)	Elmendorf	1998	31-26-29	137,338	M-R	42,874	42,610	31.03%		
1998	Homer (Crooked Cr) <sup>c</sup>	Elmendorf	1999	31-01-41	192,304	M-R	43,431	42,649	22.17%		
1999	Crooked Cr	Elmendorf	2000	31-02-31, 31-01-34,35	108,507	TI	108,507	105,578	97.30%		
2000	Crooked Cr	Elmendorf	2001	31-01-95, 31-02-36,37	109,201	TI	109,201	107,454	98.40%		
2001	Crooked Cr	Elmendorf	2002	31-02-51,31-01-96,99	99,547	TI	99,547	98,452	98.90%	Crooked Cr	2,4H4 <sup>d</sup>
2002	Crooked Cr	Ft Richardson	2003	31-02-72, 73, 68	98,800	TI	98,800	94,058	95.20%	Cook Inlet	2,3H
2002	Crooked Cr	Ft.Richardson	2004	31-02-79, 80	80,601	TI	80,601	75,120	93.20%	Cook Inlet	2,3H
2003	Crooked Cr	Ft.Richardson	2005	31-03-39, 40, 17	113,613	TI	113,071	113,499	99.90%	Cook Inlet	2,3H <sup>e</sup>
2004	Crooked Cr <sup>f</sup>	Ft.Richardson	2006	31-03-56, 57, 51	111,705	TI	111,705	111,705	100.0%	Cook Inlet	2,3H
2005	Crooked Cr	Ft.Richardson	2007	31-03-68, 31-03-52	111,382	TI	111,382	111,271	99.9%	Cook Inlet	2,3H
Deception Creek											
1991	Deception Cr	Ft Richardson	1992	31-21-03	179,724	M-R	44,089	33,464	18.60%		
1992	Deception Cr	Ft Richardson	1993	31-21-60	160,194	M-R	42,782	39,420	24.60%		
1993	Deception Cr	Ft Richardson	1994	31-23-17	177,913	M-R	46,289	45,921	25.80%		
1994	Deception Cr	Ft Richardson	1995	31-24-34	184,740	M-R	46,807	46,256	25.00%		
1995	Deception Cr	Ft Richardson	1996	31-25-14	186,918	M-R	47,700	47,145	25.20%		
1996	Deception Cr	Ft Richardson	1997	31-26-03,04,05,06,07	209,644	TI	209,644	207,973	99.20%		
1997	Deception Cr	Ft Richardson	1998	31-25-32	197,392	TI	197,392	195,615	99.10%		
1998	Deception Cr	Ft Richardson	1999	31-26-17,18,19, 20 31-01-31	201,586	TI	201,586	199,722	99.08%		
1999	Deception Cr	Ft Richardson	2000	31-26-21, 31-01-44,31-02-33,34,35	206,496	TI	206,496	205,051	99.30%		
2000	Deception Cr	Ft Richardson	2001	31-02-41,42,43,44,45	207,465	TI	207,465	204,560	98.60%		

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood		Release Year	CWT Code	Estimate	Type of Estimate <sup>a</sup>	Clipped Fish Released <sup>b</sup>	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code	
Year	Brood stock										Hatchery
Deception Creek continued											
2001	Deception Cr	Ft Richardson	2002	31-01-92,31-02-52, 53,54,55	197,277	TI	197,277	196,608	99.66%	Deception Cr	2,5H
2002	Deception Cr	Ft Richardson	2003	31-02-70, 71, 31-01-94	101,181	TI	101,181	99,562	98.40%	Cook Inlet	2,3H
2002	Deception Cr	Ft Richardson	2004	31-02-77, 78, 31-03-16	113,523	TI	113,523	104,101	91.70%	Cook Inlet	2,3H <sup>g</sup>
2003	Deception Cr	Elmendorf	2004	31-02-75, 76, 31-01-27	99,047	TI	99,047	97,660	98.60%	Cook Inlet	2,3H
2003	Deception Cr	Ft Richardson	2005	31-03-28,29,30,31	163,016	TI	161,991	162,415	99.63%	Cook Inlet	2,3H <sup>e</sup>
2004	Deception Cr <sup>f</sup>	Ft Richardson	2006	31-03-53,54,55,27	50,426	TI	50,426	50,376	99.90%	Cook Inlet	2,3H
2005	Deception Cr	Ft Richardson	2007	31-03-67,31-03-26	103,016	TI	103,016	103,016	100.00%	Cook Inlet	2,3H
Eagle River											
1993	Ship Creek	Elmendorf	1994	31-23-13	98,872	M-R	43,612	41,669	42.10%		
Eklutna Tailrace											
2001	Ship Creek	Elmendorf	2002		106,991	VOL				Eklutna Tailrace	2,3H3
2002	Ship Creek	Ft Richardson	2003		218,492	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		215,165	HI				Cook Inlet	2,3H <sup>g</sup>
2003	Ship Creek	Ft Richardson	2005		164,586	HI				Cook Inlet	2,3H <sup>c</sup>
2004	Ship Creek	Ft Richardson	2006		213,250	HI				Cook Inlet	2,3H
2005	Ship Creek	Ft Richardson	2007		110,978	HI				Cook Inlet	2,3H
Fleming Spit											
1998	Deception Cr	Ft. Richardson	1999	31-26-23	49,773	TI	45,705	45,385	91.18%		
1999	Deception Cr	Elmendorf	2000	31-01-38	45,000	VIS	17,358	17,236	38.30%		
2000	Deception Cr	Elmendorf	2001	31-02-38	94,812	HI	40,659	40,415	42.63%		
2001	Deception Cr	Ft. Richardson	2002	31-02-57	109,656	HI	40,054	39,573	36.09%	Prince William Sound	2,4H
2002	Deception Cr	Ft. Richardson	2003		109,757	HI				Prince William Sound	2,4H
2003	Deception Cr	Ft. Richardson	2004		58,000	HI				Prince William Sound	2,4H
2003	Deception Cr	Ft. Richardson	2005		87,591	HI				Prince William Sound	2,4H <sup>c</sup>
2004	Ship Creek <sup>h</sup>	Ft. Richardson	2006		113,576	HI				Cook Inlet	2,3H <sup>h</sup>
2005	Deception Cr	Ft. Richardson	2007		119,860	HI				Prince William Sound	2,4H

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Brood		Release	CWT Code	Total Released		Type of	Coded Wire Tagging			Thermal Marking	
				Estimate	Estimate <sup>a</sup>		Clipped Fish Released <sup>b</sup>	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code
Year	Brood stock	Hatchery	Year								
<b>Halibut Cove</b>											
1993	Crooked Creek	Elmendorf	1994	31-23-15	98,872	M-R	21,205	21,038	21.30%		
1994	Ninilchik River	Elmendorf	1995	31-24-30	37,577	M-R	36,944	36,700	97.70%		
1995	Ninilchik River	Elmendorf	1996	31-25-11	97,729	M-R	40,688	39,345	40.30%		
1996	Ninilchik River	Elmendorf	1997	31-25-58	78,133	M-R	40,919	39,487	50.54%		
1997	Ninilchik River	Elmendorf	1998	31-26-32	65,893	M-R	38,476	38,041	57.73%		
	Ninilchik River	Elmendorf	1999-01 <sup>i</sup>								
2001	Ninilchik River	Elmendorf	2002		106,279	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		106,844	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		103,771	HI				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		112,521	HI				Cook Inlet	2,3H <sup>e</sup>
2004	Ninilchik River	Ft Richardson	2006		117,549	HI				Cook Inlet	2,3H
2005	Ninilchik River	Ft Richardson	2007		54,560	HI				Cook Inlet	2,3H
<b>Homer Spit (early run)</b>											
1993	Crooked Creek	Elmendorf	1994	31-23-16	163,963	M-R	26,003	25,615	15.60%		
1994	Homer (Crooked Cr)	Elmendorf	1995	31-24-32	216,026	M-R	41,650	40,291	18.70%		
1995	Homer (Crooked Cr)	Elmendorf	1996	31-25-07	204,085	M-R	40,868	39,017	19.10%		
1996	Homer (Crooked Cr)	Elmendorf	1997	31-25-60	217,773	M-R	41,112	38,810	17.82%		
1997	Homer (Crooked Cr)	Elmendorf	1998	31-26-33	177,730	M-R	40,012	39,652	22.31%		
1998	Homer (Crooked Cr)	Elmendorf	1999	31-01-45	163,170	M-R	42,561	40,423	24.77%		
	Ninilchik River	Elmendorf	2000-01 <sup>i</sup>								
2001	Ninilchik River	Elmendorf	2002		190,026	VOL				Kachemak Bay	2,5H3
2002	Ninilchik River	Ft Richardson	2003		206,292	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		143,037	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elmendorf	2004		25,706	VOL				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		220,822	HI				Cook Inlet	2,3H <sup>e</sup>
2004	Ninilchik River	Ft Richardson	2006		224,053	HI				Cook Inlet	2,3H
2005	Ninilchik River	Ft Richardson	2007		226,972	HI				Cook Inlet	2,3H
<b>Homer Spit (late run)</b>											
1992	Kasilof River	Crooked Creek	1994	31-23-19	56,920	M-R	22,612	22,383	39.30%		
1994	Homer (Kasilof R)	Elmendorf	1995	31-24-33	123,048	M-R	41,054	40,466	32.90%		
1995	Homer (Kasilof R)	Elmendorf	1996	31-25-13	108,204	M-R	40,615	38,787	35.80%		
1996	Homer (Kasilof R)	Elmendorf	1997	31-25-61	100,933	M-R	41,028	39,264	38.90%		
1997	Homer (Kasilof R)	Elmendorf	1998	31-26-34	112,100	HI	40,158	39,997	35.68%		
	Homer (Kasilof R)	Elmendorf	1999 <sup>j</sup>								

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Fish Released <sup>b</sup>	Fish Released	Tagged	Mark Group	Hatch Code
Lowell Creek											
1996	Deception Cr	Elmendorf	1997	31-25-59	102,147	M-R	40,906	40,497	39.65%		
	Deception Cr	Elmendorf	1998-99 <sup>i</sup>								
	Crooked Creek	Elmendorf	2000-01 <sup>i</sup>								
2001	Crooked Creek	Elmendorf	2002		93,296	VOL				Resurrection Bay	2,5H3
2002	Crooked Creek	Ft Richardson	2003		110,331	HI				Resurrection Bay	2,5H
2002	Crooked Creek	Ft Richardson	2004		89,388	HI				Resurrection Bay	2,5H
2003	Crooked Creek	Ft Richardson	2005		100,088	HI				Resurrection Bay	2,5H <sup>e</sup>
Ninilchik River											
1991	Ninilchik River	Ft Richardson	1992	31-21-04	132,387	M-R	43,648	41,335	31.20%		
1992	Ninilchik River	Ft Richardson	1993	31-21-59	184,585	M-R	44,487	42,960	23.30%		
1993	Ninilchik River	Ft Richardson	1994	31-23-18	201,513	M-R	46,193	45,535	22.60%		
1994	Ninilchik River	Ft Richardson	1995	31-24-35	54,902	TI	54,902	54,353	99.00%		
1995	Ninilchik River	Ft Richardson	1996	31-25-15	51,688	TI	51,588	50,866	98.60%		
1996	Ninilchik River	Ft Richardson	1997	31-26-08	50,698	TI	50,698	50,292	99.20%		
1997	Ninilchik River	Ft Richardson	1998	31-26-35	48,798	TI	48,798	47,480	97.30%		
1998	Ninilchik River	Ft Richardson	1999	31-01-47	49,853	TI	49,853	48,906	98.10%		
1999	Ninilchik River	Ft Richardson	2000	31-02-48	51,298	TI	51,298	50,016	97.50%		
2000	Ninilchik River	Ft Richardson	2001	31-02-60	54,770	TI	54,770	54,441	99.40%		
2001	Ninilchik River	Ft Richardson	2002	31-02-82	54,631	TI	54,631	54,139	99.10%	Ninilchik River	2,3H
2002	Ninilchik River	Ft Richardson	2003	31-02-56, 31-01-83	47,997	TI	47,997	44,349	92.40%	Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004	31-03-18	51,303	TI	51,303	51,252	99.90%	Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005	31-03-41	55,229	TI	54,806	54,898	99.40%	Cook Inlet	2,3H <sup>e</sup>
2004	Ninilchik River <sup>f</sup>	Ft Richardson	2006	31-03-58	57,537	TI	57,537	57,537	100.00%	Cook Inlet	2,3H
2005	Ninilchik River	Ft Richardson	2007	31-03-66	56,325	TI	56,037	56,156	99.70%	Cook Inlet	2,3H

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				Total Released			Coded Wire Tagging			Thermal Marking	
Brood		Release			Type of		Clipped	Tagged	Percent		
Year	Brood stock	Hatchery	Year	CWT Code	Estimate	Estimate <sup>a</sup>	Fish Released <sup>b</sup>	Fish Released	Tagged	Mark Group	Hatch Code
<b>Seldovia</b>											
1993	Crooked Creek	Elmendorf	1994	31-23-11	107,246	M-R	46,754	45,439	42.40%		
1994	Homer (Crooked Cr)	Elmendorf	1995	31-24-29	116,165	M-R	41,609	40,678	35.00%		
1995	Ninilchik River	Elmendorf	1996	31-25-10	118,274	M-R	40,667	39,610	33.50%		
1996	Ninilchik River	Elmendorf	1997	31-25-57	103,757	M-R	41,279	39,834	38.39%		
1997	Ninilchik River	Elmendorf	1998	31-26-31	69,461	M-R	40,654	40,125	57.77%		
	Ninilchik River	Elmendorf	1999-01 <sup>i</sup>								
2001	Ninilchik River	Elmendorf	2002		83,045	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		107,521	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elmendorf	2004		88,682	VOL				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		114,984	HI				Cook Inlet	2,3H <sup>e</sup>
2004	Ninilchik River	Ft Richardson	2006		113,974	HI				Cook Inlet	2,3H
2005	Ninilchik River	Ft Richardson	2007		54,276	HI				Cook Inlet	2,3H
<b>Seward Lagoon</b>											
2001	Crooked Creek	Elmendorf	2002		100,314	VOL				Resurrection Bay	2,5H3
2002	Crooked Creek	Ft. Richardson	2003		109,976	HI				Resurrection Bay	2,5H
2003	Crooked Creek	Elmendorf	2004		109,600	VOL				Resurrection Bay	2,5H
2003	Crooked Creek	Ft. Richardson	2005		114,847	HI				Resurrection Bay	2,5H <sup>e</sup>
2004	Deception/Crooked Crs	Ft. Richardson	2006		116,826	HI				Resurrection Bay	2,5H
2004	Ship Creek <sup>h</sup>	Ft. Richardson	2006		109,795	HI				Cook Inlet	2,3H <sup>h</sup>
<b>Ship Creek</b>											
1993	Ship Creek	Elmendorf	1994	31-23-12	199,830	M-R	44,138	42,864	21.50%		
1994	Ship Creek	Elmendorf	1995	31-24-28	218,487	M-R	40,764	38,570	17.70%		
1995	Ship Creek	Elmendorf	1996	31-25-08	231,444	M-R	41,221	40,109	17.30%		
1996	Ship Creek	Elmendorf	1997	31-25-56	326,371	M-R	40,522	40,319	12.36%		
1997	Ship Creek	Elmendorf	1998	31-26-30	204,741	M-R	42,073	41,565	20.30%		
1998	Ship Creek	Elmendorf	1999	31-01-42	197,168	M-R	44,265	42,262	21.44%		
	Ship Creek	Elmendorf	2000-01 <sup>i</sup>								
2001	Ship Creek	Elmendorf	2002		290,501	VOL				Ship Creek	2,4H4
2002	Ship Creek	Ft Richardson	2003		329,416	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		209,060	HI				Cook Inlet	2,3H <sup>g</sup>
2003	Ship Creek	Elmendorf	2004		111,166	HI				Cook Inlet	2,3H
2003	Ship Creek	Ft Richardson	2005		344,191	HI				Cook Inlet	2,3H <sup>e</sup>
2004	Ship Creek	Elmendorf	2005		13,838	VOL					

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					Total Released		Coded Wire Tagging			Thermal Marking	
Brood		Release Year	CWT Code	Estimate	Type of Estimate <sup>a</sup>	Clipped Fish Released <sup>b</sup>	Tagged Fish Released	Percent Tagged	Mark Group	Hatch Code	
Year	Brood stock					Hatchery	Estimate	Estimate <sup>a</sup>			Released <sup>b</sup>
Ship Creek continued											
2004	Ship Creek	Ft Richardson	2006		60,412	HI				Cook Inlet	2,3H
2004	Ship Creek <sup>h</sup>	Ft Richardson	2006		115,643	HI				Prince William Sound	2,4H <sup>h</sup>
2005	Ship Creek	Ft Richardson	2007		333,940	HI				Cook Inlet	2,3H
Valdez Area											
1998	Deception Cr	Ft Richardson	1999	31-26-22	49,353	TI	46,528	45,923	93.05%		
1999	Deception Cr	Elmendorf	2000	31-01-37	115,582	M-R	41,728	41,060	35.52%		
2000	Deception Cr	Elmendorf	2001	31-02-39	94,701	HI	44,418	43,974	46.43%		
2001	Deception Cr	Ft Richardson	2002	31-02-58	107,861	HI	43,833	42,650	39.54%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,661	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		99,464	HI				Prince William Sound	2,4H <sup>g</sup>
2003	Deception Cr	Ft Richardson	2005		143,209	HI				Prince William Sound	2,4H <sup>e</sup>
2004	Ship Creek	Ft Richardson	2006		112,221	HI				Prince William Sound	2,4H
2005	Deception Cr	Ft Richardson	2007		126,241	HI				Prince William Sound	2,4H
Whittier Area											
1998	Deception Cr	Ft Richardson	1999	31-26-24	49,797	TI	45,023	43,897	88.21%		
1999	Deception Cr	Elmendorf	2000	31-01-39	119,389	M-R	43,551	42,898	35.93%		
2000	Deception Cr	Elmendorf	2001	31-02-40	95,823	HI	42,800	42,458	44.31%		
2001	Deception Cr	Ft Richardson	2002	31-02-59	109,763	HI	45,854	44,799	40.81%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,700	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		107,705	HI				Prince William Sound	2,4H <sup>g</sup>
2003	Deception Cr	Elmendorf	2004		20,906	VOL				Prince William Sound	2,4H
2003	Deception Cr	Ft Richardson	2005		118,059	HI				Prince William Sound	2,4H <sup>e</sup>

<sup>a</sup> M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory estimate, VIS is a visual estimate, VOL is volumetric estimate.

<sup>b</sup> Beginning in 2005, number of clipped fish released is adjusted to reflect percentage of acceptable finclips observed at release.

<sup>c</sup> Corrections for release numbers reported in the 1999 report.

<sup>d</sup> See 2001 - 2003 marking report for altered mark details.

<sup>e</sup> See 2005 marking report for altered mark details.

<sup>f</sup> Not sampled for long-term CWT retention or finclip quality at release. CWT data based on overnight tag retention and acceptable finclip rates.

<sup>g</sup> See 2004 marking report for altered mark details

<sup>h</sup> Due to a BKD infection, release groups were switched at release in order to stock healthier fish at brood source release sites.

<sup>i</sup> Stocking continued, but releases did not contain tagged or thermally marked fish.